Value Engineering

Draft Report for Presentation

(Not for Distribution)

Removal of Elwha and Glines Canyon Dams, Elwha River Ecosystem and Fisheries Restoration Project

(A1R-1751-3408-NPS-20-0-0-1; ELWCD and A1R-1751-3408-NPS-21-0-0-1; GLINS)

April 25, 2003

Conducted in Cooperation with the National Park Service, Olympic National Park and the Bureau of Reclamation, Pacific Northwest Region

Bureau of Reclamation, Technical Service Center, Denver, Colorado

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Executive Summary

The Value Study Team met on April 21, 2003, for a 4 1/2-day study of the proposed removal of Elwha and Glines Canyon Dams, in and adjacent to Olympic National Park. The dams are to be removed in support of restoration of the Elwha River ecosystem. The estimated field cost of the baseline concept to remove the dams is $25,000,000. The Team developed 5 proposals which are summarized below. If all the savings proposals are accepted, their maximum savings potential is $4,640,000. Note that in calculating the maximum potential savings, the implementation costs for Proposal 2 ($30,000) and the costs of the study ($30,000) were deducted only once.

Proposals 1, 2, and 3 are independent of all other proposals and could be accepted or rejected individually without affecting other proposals. All proposals can be combined in any combination except Proposals Nos. 4 and 5 which are mutually exclusive of each other.

<u>Proposal No. 1</u>. Refine/Clarify Conditions/Criteria for Negotiated Contract. The estimated savings of this proposal were not determined.

<u>Proposal No. 2</u>. Establish streamflow diversion through gravity section of Elwha Dam. The estimated savings of this proposal are $1,400,000 before deducting any study and/or implementation costs.

<u>Proposal No. 3</u>. Elwha Dam Landscape Contouring of Left Side Intake, Penstock and Powerhouse Area. The estimated savings of this proposal are $300,000 before deducting any study and/or implementation costs.

<u>Proposal No. 4</u>. Draw Down Lake Mills Prior to Dam Removal Using Existing Facilities. The estimated savings of this proposal are $1,100,000 before deducting any study and/or implementation costs.

<u>Proposal No. 5</u>. Draw Down Lake Mills Prior to Dam Removal Using Newly-Constructed Low-Level Outlet. The estimated savings of this proposal are $3,000,000 before deducting any study and/or implementation costs.

Other Ideas: The Team identified 40 additional ideas that are listed in the “Disposition of Ideas” table near the end of this report.

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Acknowledgment of Design Team and Consultant Assistance

The Value Study Team wishes to express their thanks and appreciation to the Design Team Leader, Mr. Tom Hepler, and the members of the design team, who fully and cordially provided all requested information and consultation on the conceptual design. The team would not have been as successful without the design team's cooperation and assistance.

The Value Study Team wishes also to express thanks and appreciation to those listed on the Consultation Record of this report. Their cooperation and help contributed significantly to the technical foundation and scope of the team's investigation and final proposals.

The goal of the value method is to achieve the most appropriate and highest value solution for the project. It is only through the effort of a diverse, high performing team, including all those involved, that this goal can be achieved. This study is the product of such an effort.

Value Method Process

The Value Method is a decision making process, originally developed in 1943 by Larry Miles, to creatively develop alternatives that satisfy essential functions at the highest value. It has many applications but is most often used as a management or problem-solving tool.

The study process follows a Job Plan that provides a reliable, structured approach to the conclusion. Initially, the team examined the component features of the program, project or activity to define the critical functions (performed or desired), governing criteria, and associated costs. Using creativity (brainstorming) techniques, the team suggested alternative ideas and solutions to perform those functions, consistent with the identified criteria, at a lower cost or with an increase in long term value. The ideas were evaluated, analyzed and prioritized, and the best ideas were developed to a level suitable for comparison, decision making and adoption.

This report is the result of a "formal" Value Study, by a team comprised of people with the diversity, expertise, and independence needed to creatively attack the issues. The team members bring a depth of experience and understanding of the discipline they represent, and an open and independent enquiry of the issues under study, to creatively solve the problems at hand. Ideally, the team members have not been notably involved in the issues prior to the study. The team applied the Value Method to the issues and supporting information, and took a "fresh look" at the problems to create alternatives that fulfill the client's needs at the greatest value.

Elwha and Glines Canyon dams are located on the Elwha River, in or adjacent to Olympic National Park, Washington. Elwha dam is located north of the Park, at river mile 4.9 (4.9 miles upstream of the mouth of the River). Glines Canyon Dam is located inside the Park, at river mile 12.8. See Figure 1. See Figures 2 and 3 for site plans of Elwha and Glines Canyon dams.

The Elwha River Ecosystem and Fisheries Restoration Act, PL 102-495, calls for full restoration of the ecosystem and native anadromous species in the Elwha River watershed, including deconstruction of the Elwha and Glines Canyon Dams. The National Park Service (NPS) is the lead agency for the Federal Government for this project. Reclamation is providing design support through an interagency agreement to the NPS.

The overall project includes removal of Elwha and Glines Canyon dams, construction of a new M&I river intake structure, an industrial water treatment plant, a new municipal water treatment plant, flood protection measures, protection for the Dry Creek Water Association, and implementing revegetation and fish restoration plans.

This study focuses on the removal of the dams. The estimated Field cost for removal of Elwha Dam is $12,000,000. The estimated field cost for the removal of Glines Canyon Dam is $13,000,000. These costs exclude costs associated with decommissioning the existing powerplants.

The baseline concept for removing the dams includes lowering the reservoirs using spillways and penstocks, at a controlled rate to avoid mobilizing landslides and to redistribute reservoir sediments to minimize leaving over steepened slopes. Sedimentation modeling has been performed to help minimize adverse impacts of sediment releases. Glines Canyon Dam removal would be delayed for a few months to provide flood protection until a diversion channel is completed in the left or north spillway at Elwha Dam. Deconstruction of both dams would then begin.

The Elwha damsite is a culturally significant site. As part of the mitigation for removal of Elwha Dam (a National Register Property) the NPS is restoring the cultural landscape in accordance with consultation processes under the National Historic Preservation Act. The dam and all associated appurtenances are to be obliterated and/or removed to restore the site to near pre-dam appearances.

At Glines Canyon, the arch section of the dam, transformer yard and transmission lines, outlet works intake tower, surge tank, the left abutment dike and boathouse will be removed. The spillway section (on the left abutment), the thrust block (on the right abutment) and right abutment dike, powerhouse, and penstocks will be retained to reduce removal costs and to interpret history associated with the dam. The deconstructed elements of the Glines Canyon Dam will be removed from the Park consistent with the Organic Act.

Current Description

As the dams are removed (short-term), some of the entrapped sediments will be released in high concentration periods, as notches are cut lower and lower in the dams. High concentration releases will be prohibited at identified periods, “Fish Windows”, to protect anadromous species migrating and or spawning in the lower reaches of the river from lethal concentrations of sediments.

Figure 1. Location Map.

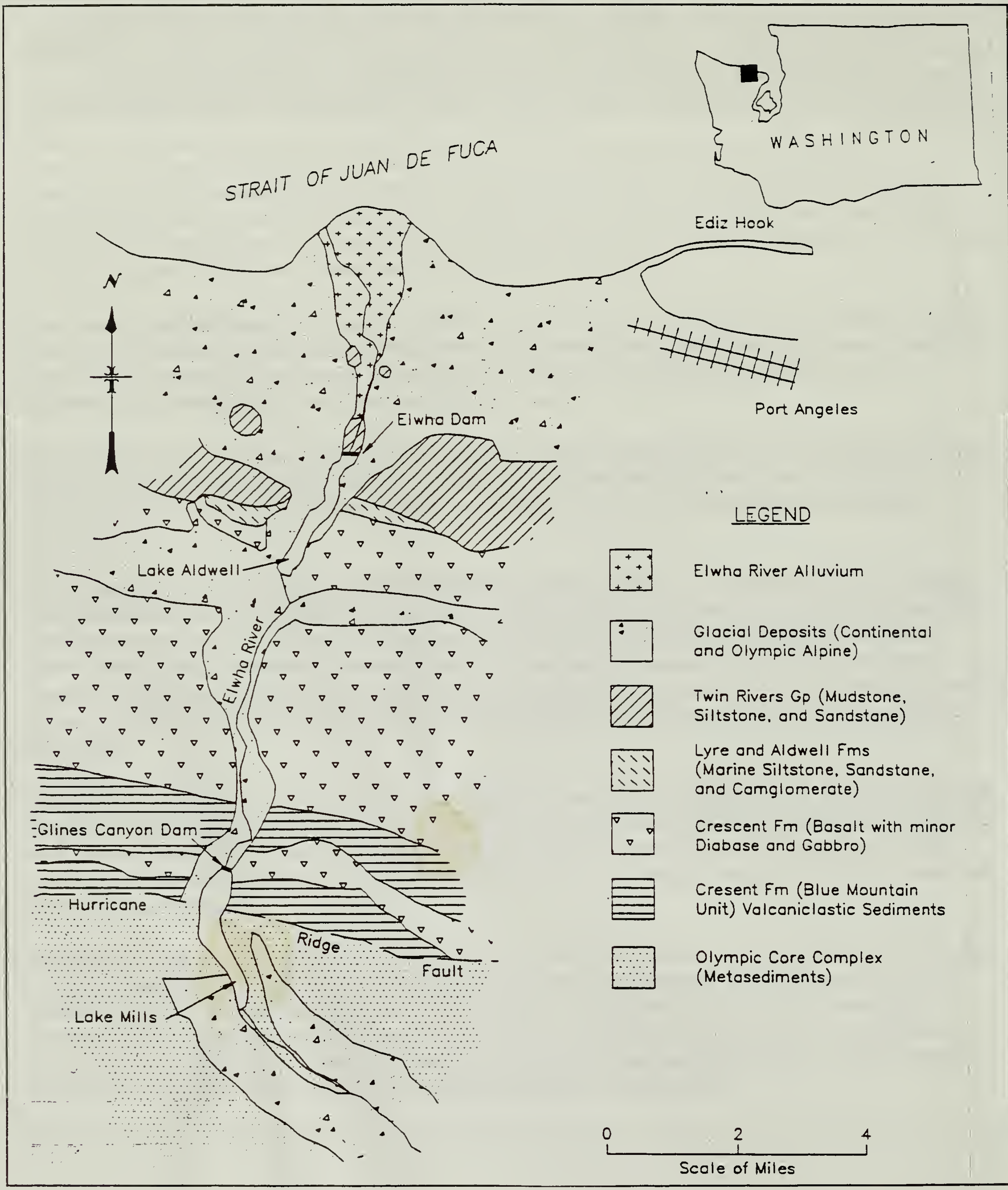


Figure 2. Elwha Dam Site Plan.

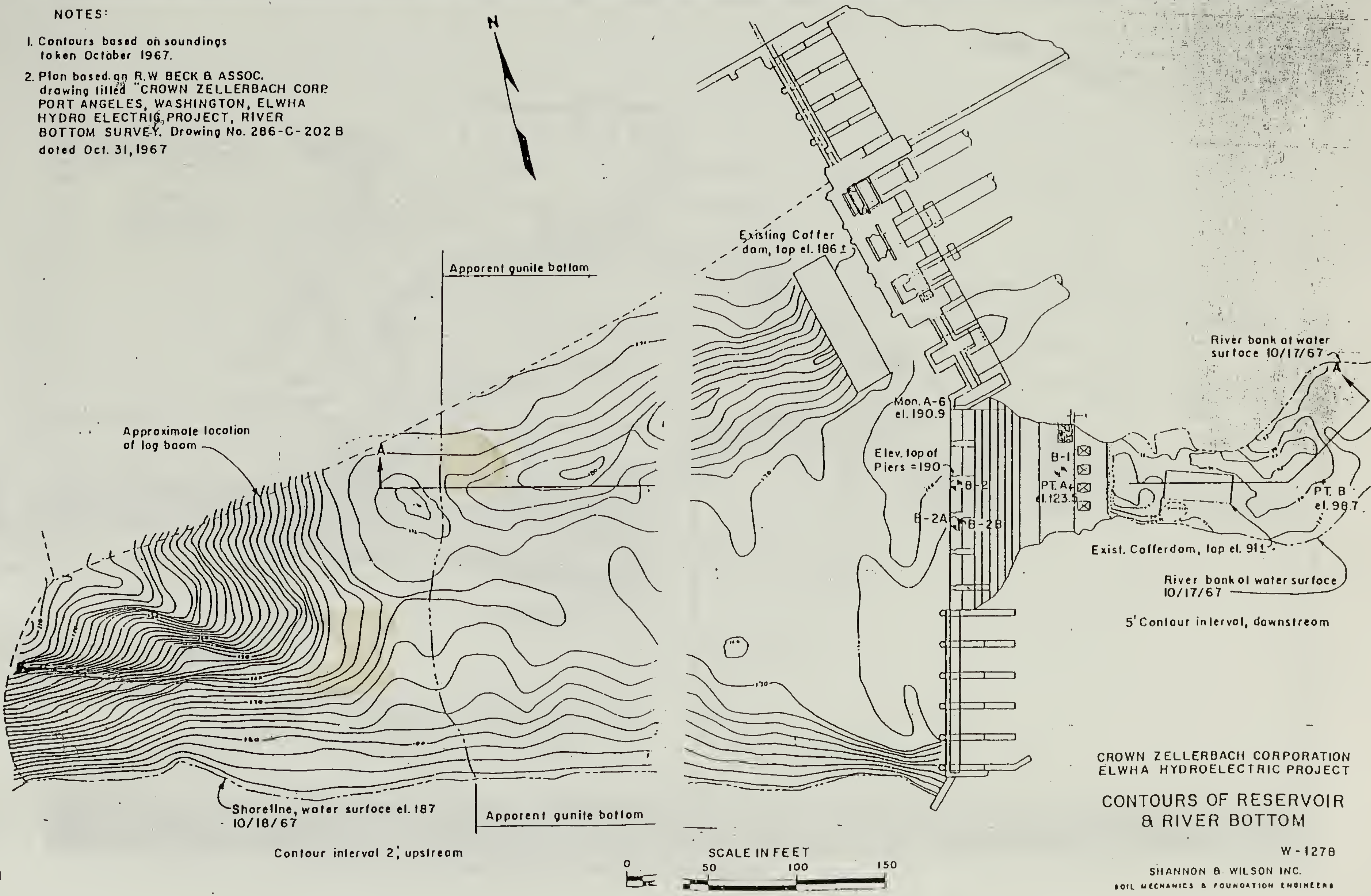
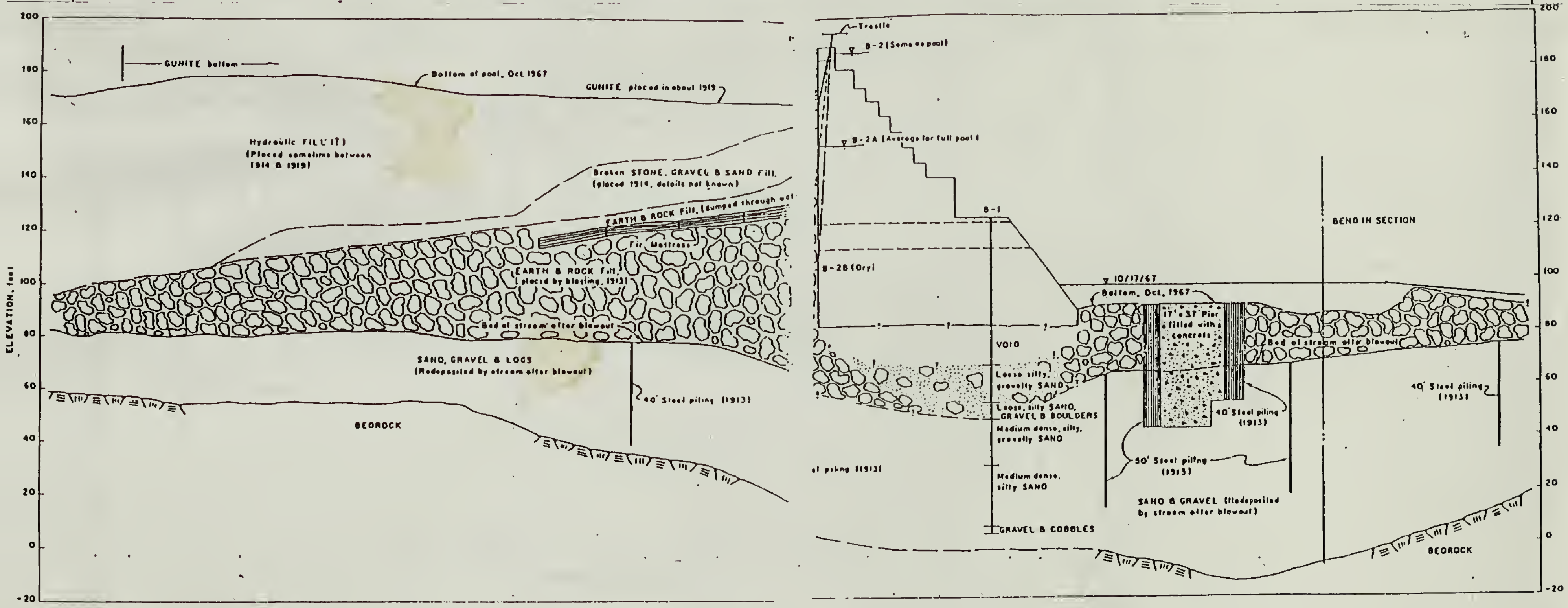


Figure 3. Elwha Dam Cross Section.



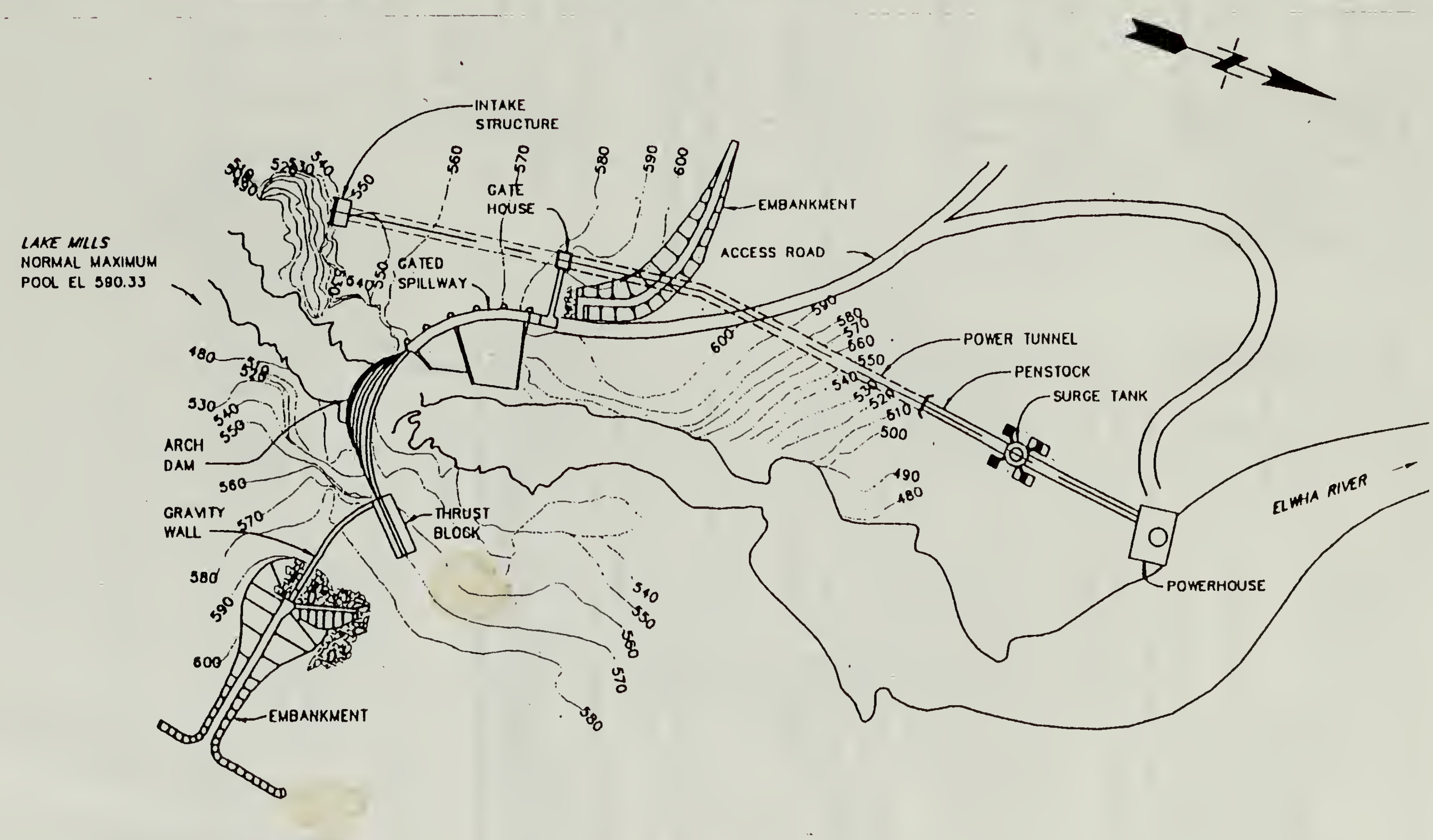
NOTE:

Cross-section based on Mead & Seastone drawing titled "CROSS-SECTION OF DAM, OLYMPIC POWER CO. INC.", Port Angeles, Washington, dated Feb. 15, 1914.

CROWN ZELLERBACH CORPORATION
ELWHA HYDROELECTRIC PROJECT

CROSS - SECTION OF DAM

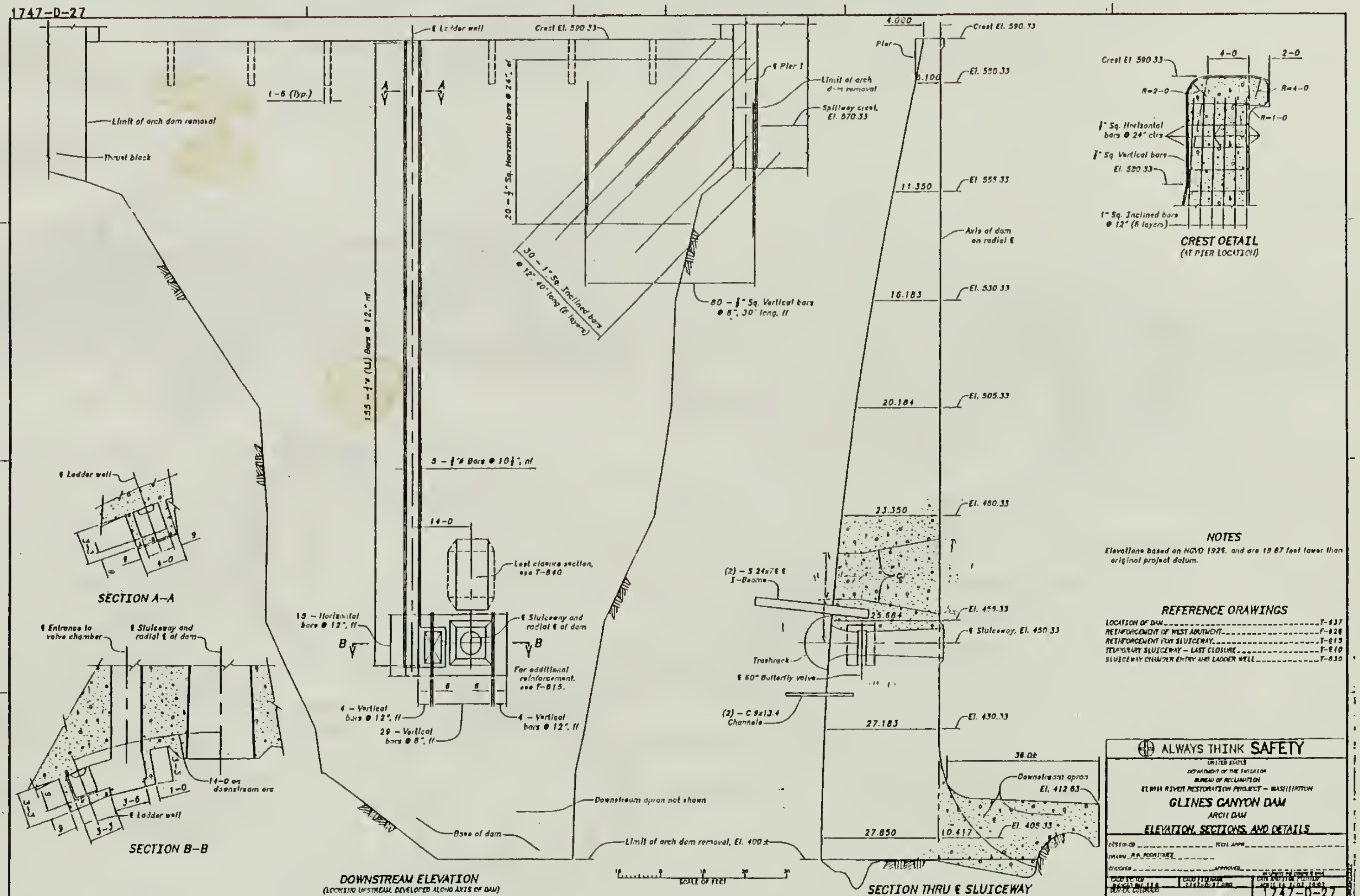
Figure 4. Glines Canyon Dam Site Plan.



NOTE

1. ELEVATIONS ARE REFERENCED TO MEAN SEA LEVEL (M.S.L.) BASED ON NVGD, 1929; PROJECT VERTICAL DATUM IS 19.67 FEET HIGHER THAN M.S.L.

Figure 5. Glines Canyon Dam Cross Section.



Owner, Users, and Stakeholders List

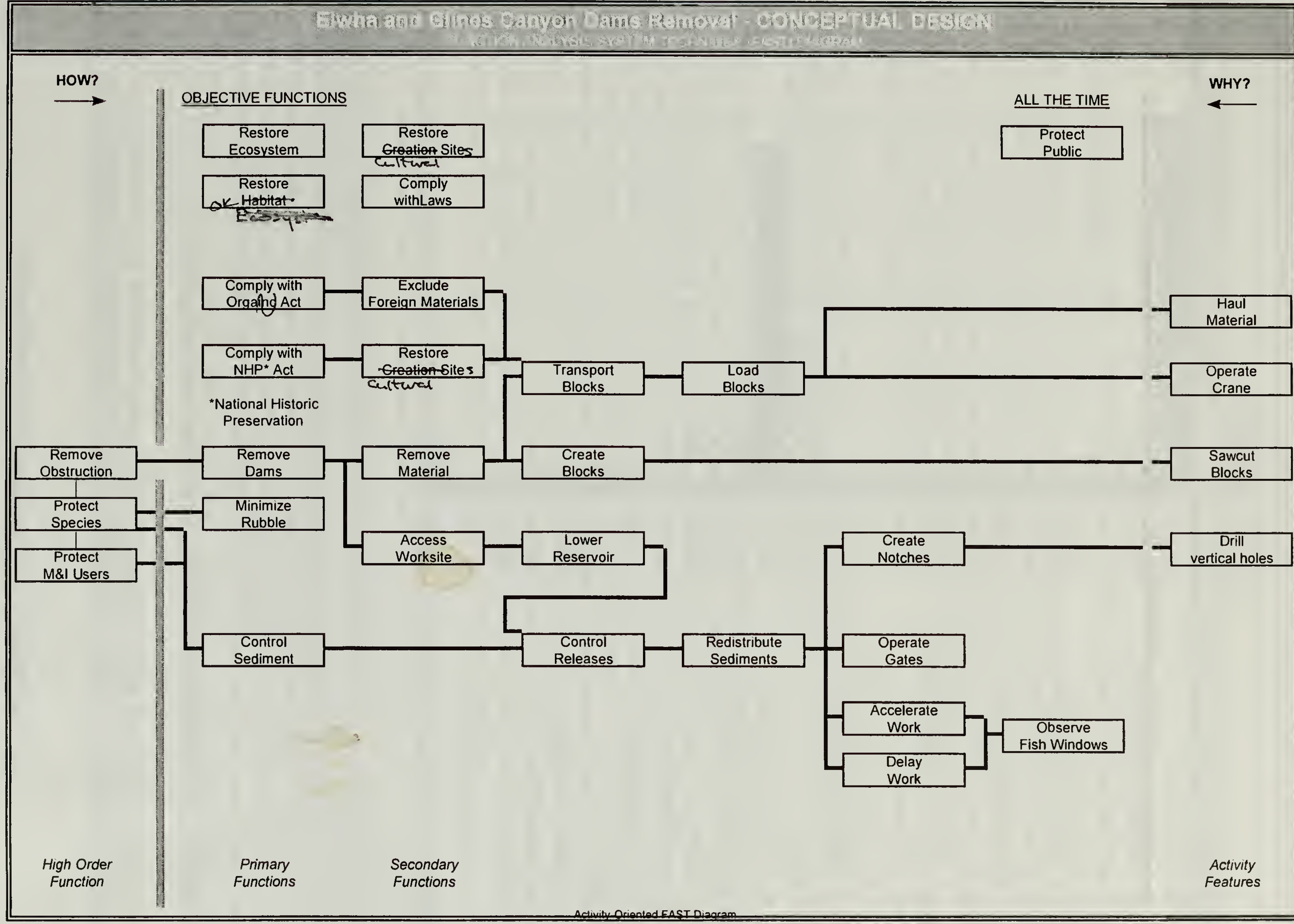
Owner (Identification of the owner or owners)	Owner Issues (Identification of issues important to every owner)	Desire/ Criteria?
National Park Service	Native Anadromous ~~habitat~~ fisheries restoration Elwha Act ~~compliance~~ NHPA	C C
User (Identification of the user or users)	**User Issues** (Identification of issues important to every user)	**Desire/ Criteria?**
City of Port Angeles	Maintenance of water quality and supply Operations and maintenance effort/costs ~~Groundwater under influence (GWI) of~~ Surface Water Rule compliance	C ~~C~~ D C
Daishowa Mill	Industrial water quality and supply Operations and maintenance effort/costs	C ~~C~~ D
Lower Elwha Klallam Tribe	Restoration of ~~sacred creation~~ cultural and historic sites Hatchery ~~Fishery~~ water quality and supply Native Anadromous ~~species habitat~~ fisheries restoration	C C C
Washington State Department of Fish and Wildlife	Rearing Channel ~~Fishery~~ water quality and supply Native Anadromous ~~species habitat~~ fisheries restoration	C C
Dry Creek Water Association, Elwha Place Water Association	Water quality and supply Operations and maintenance effort/costs	C D
Stakeholder (Identify of the stakeholder or stakeholders)	**Stakeholder Issues** (Identification of issues important to every stakeholder)	**Desire/ Criteria?**
Washington State Historic Preservation Office	Mitigation of proposed loss of historic listed structures (both dams are listed)	C
Clallam County	Permitting	C

Function Analysis

Component	Active Verb	Measurable Noun
Saw cut area outside notches	Detach Create Control Control Minimize Minimize Create Create Use Restrict	Concrete Blocks Demolition Elevation Rubble Noise Dust Mud Time Progress
Crane and crew	Move Remove Lift Remove Recover Remove	Equipment Material Blocks Logs Debris Sediment
Haul materials to waste area	Clear Remove Avoid Prevent Increase Increase Damage	Site Obstruction Erosion Pollution Traffic Air Pollution Roads

Function Analysis System Technique (FAST)

The Value Study Team used the function-analysis process to generate a Function Analysis System Technique (FAST) diagram, designed to describe the present solution from a functional point of view. The FAST diagram helped the Team identify those design features that support critical functions and those that satisfy noncritical objectives. The FAST diagram also helped the Team focus on potential value mismatches, and generate a common understanding of how project objectives are met by the present solution.



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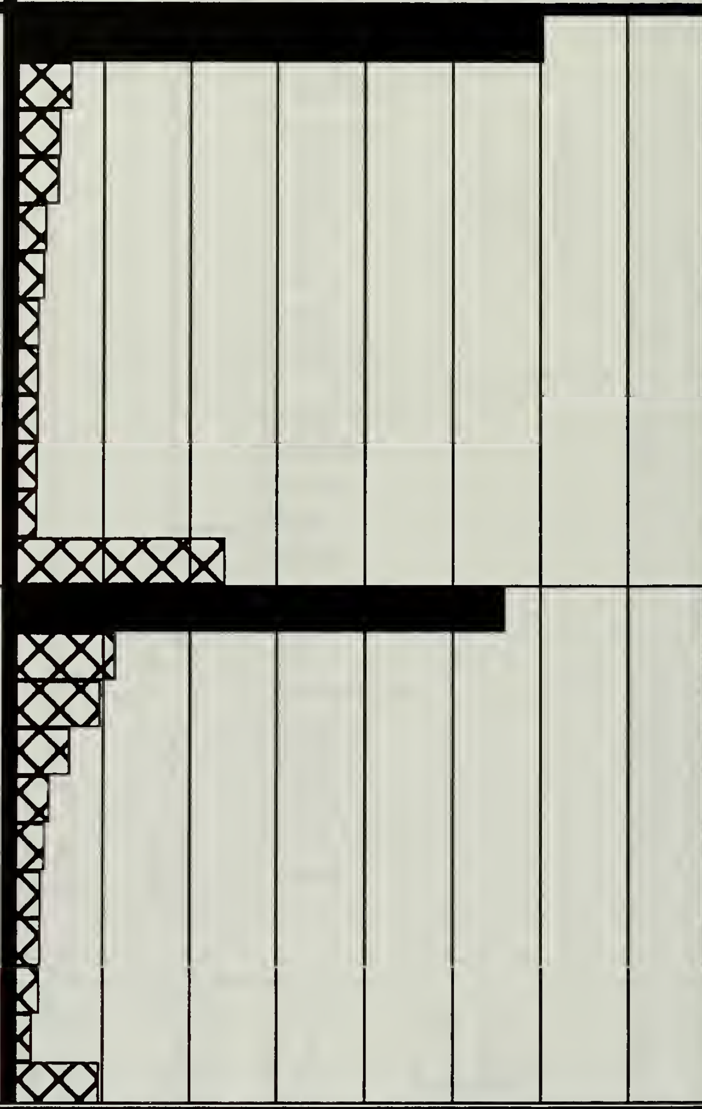
Elwah and Glines Canyon Dams Removal

VALUE STUDY

COST MODEL

COMPONENT/PERCENT PROJECT COST	
Elwha Dam Removal	(51.9%)
Haul materials to waste site	(5.5%)
Remove Concrete in Gravity -	(4.4%)
Remove penstock, steel pipe	(4.3%)
Remove Intake Structure, Rein	(3.0%)
Remove Electrical Equipment	(2.8%)
Mobilization	(2.3%)
Remove Powerhouse Super conc	(2.3%)
Excavate U/S forebay -145	(2.2%)
Remove No Spillway Rein conc	(2.1%)
Conc in powerhouse Substru	(2.1%)
All other items	(20.8%)
Glines Canyon Dam Removal	(48.1%)
Sawcut area outside notches	(9.9%)
Crane and crew	(8.5%)
Drill vert for 7.5' blocks	(5.4%)
Drill vert for 15' blocks	(3.4%)
Mobilization	(3.0%)
Sawcut in reinforced area	(2.6%)
Controlled blasting lifts 1-17	(2.6%)
Setups lifts 1-7	(2.4%)
Remove concrete blocks from	(1.7%)
All other items	(8.4%)

PROJECT COST PROPORTION



Cost Model and Estimate Information

The Value Study Team cost model is based on the conceptual design estimates provided by the design team for the preferred project design. The cost model was developed by the Value Study Team and was used to focus on features with the greatest potential for savings and to highlight areas of value mismatch. Unit prices were reviewed by the Cost Estimator and Value Study Team members, to ensure reliability and applicability.

Cost avoidances/savings and the original design concept estimates are of the same general level of development, although these costs may vary as final designs are pursued.

Description

Proposal No. 1. Refine/Clarify Conditions/Criteria for Negotiated Contract.

- Proposal Description: Refine criteria as possible to be less restrictive and/or clarify criteria:

  Revisit 7.5 feet lift height limit and minimum interval between demolition lifts where it applies at each dam to allow greater contractor flexibility. For example, Proposal No. 4 evacuates Lake Mills to elevation ~515 during the year prior to initiating demolition of Glines Canyon Dam. Under this scenario, there is no need to restrict the lift height limit or minimum interval to accommodate redistribution of delta sediments since that has already occurred. Alternatively, changing the method of demolition from the baseline would not eliminate the need to restrict the height or minimum interval of lifts.

  Clarify minimum downstream release to include "...or natural flow, whichever is less." This change makes it clear that the contractor will not be required to store water to maintain a minimum flow above natural inflow.

  Allow reservoir drawdowns during fish windows if resulting turbidities do not exceed historic background levels during that time of year, as established by Reclamation. The fish windows were designed to ensure that adult salmon and steelhead enter the river during peak immigration periods as well as to protect downstream migrants when released from the hatchery facilities. The concern is primarily related to the release of accumulated sediments at levels that would exceed fish mortality rates or cause adult fish to avoid entering the river. Determining the natural turbidity of the river could allow for the development of thresholds that would allow some instream work or initial dam demolition activities during fish windows that would not adversely affect fish. The thresholds would need to be approved by the permitting agencies, including the WDFW and Tribe. Monitoring of water quality during some activities may be needed to make sure that the threshold level(s) are not exceeded.

  Allow reservoir drawdowns to resume near the end of fish windows if adequate numbers of adult salmon and steelhead have been collected by that time (requires approval of WDFW and Tribe). Adult salmon and steelhead will be collected and removed from the river during the fish windows. The goal of the agencies and Tribe will be to collect as many fish as possible. However, there could be times when fish collection needs have been met so initiation of dam removal could be allowed to begin again prior to the scheduled end of a fish window. This would require close coordination with the WDFW and Tribe. In addition, cost recovery could be justified if contractor down time is reduced.

- Critical Items to Consider: May need concurrence of permitting agencies and monitoring to ensure compliance.

- Ways to Implement: Include in contract bid specifications and allow cost exchange if contractor down time(s) are reduced.

- Changes from the Baseline Concept: Modifications to baseline construction constraints.

Advantages	Disadvantages
• Contractor flexibility • Reduced dam demolition delays related to fish windows • Possible cost recovery if contractor down time is reduced	• May require compliance monitoring • Requires determination of natural background water quality conditions during fish windows and concurrence by permitting agencies and Tribe • Requires active communication with WDFW and Tribe during adult salmon and steelhead collection efforts

Potential Risks

Potential monitoring requirements could result in additional uncertainty for criteria dependent on that.

Cost Items	Nonrecurring Costs
Original Baseline Concept	$ 0
Value Concept	$ 0
Savings	$ 0
Value Study Costs	$ 0
Implementation Costs	$ 0
Net Savings	**$ 0**

Description

Proposal No. 2. Establish streamflow diversion through gravity section of Elwha Dam.

- Proposal Description: Establish the diversion channel through the gravity section where the river channel is located.

- Critical Items to Consider:

Excavating through and then diverting water over the upstream fill will recharge the fill and increase seepage flows under the dam. In the past, such flows have exceeded 120 cfs. However, the VE team noted that large rockfill (2 - 40 ton boulders) was placed to fill the void under the dam and increase the upstream seepage path, resulting in refilling of the reservoir to the spillway crest. The VE team also noted that sheet piling and a downstream concrete caisson were constructed to stabilize the dam foundation. There was no report of dam movement prior to or after placement of the upstream fill. While the seepage flows under the dam will increase as a result of this action, it is the opinion of the VE team that it will have no impact on the structural integrity of the dam during removal, nor will the seepage be sufficient in comparison to releases through the diversion channel to cause flooding downstream of the work. Stability and seepage analysis will need to be performed to verify the VE team's opinion. If the analysis does indicate a risk, mitigation measures could be implemented including stabilizing the downstream toe.

Routing of flows through the gravity dam may result in a public perception of increased risk. This will need to be addressed by a public awareness program.

Due to the small size of the reservoir, the diversion must be capable of passing expected flows with out impacting the project. The diversion channel presented herein should safely pass a flow of 3,000 cfs.

Constraints have been placed on the draw down rate of the reservoir, the ramping of downstream flows, and the maintenance of minimum river flows. The diversion method described herein allows control of all these parameters by selective demolition of plugs, and passing of all flows. The diversion channel is also readily accessible to equipment at all times for removal of any blockage.

numbers reversed on Figures

- Ways to Implement: See Figures 6 and 7 for schedule of implementation.

1. Drawdown reservoir from El 197 to El 173+/- using Lt and Rt spillways and penstocks at a rate of 1 ½' per day limiting ramping to 1,000 cfs per hour. This is the same as the baseline but may be done following decommissioning of the power plant and before award of the contract.
2. Mobilize crane to Rt spillway and demolish bridge/walkway over Rt spillway and Rt half of gravity dam.

3. Install two 4' high coffer dams, on the gunite cap at elevation 170 to isolate the gravity dam from the reservoir. For the purpose of this proposal, two water bladders measuring 4' by 12' by 75' were assumed.
4. Mobilize small hoe ram, skip loader and skip to site, all capable of being placed on the gravity dam by the crane, and demolish the two piers in the first three bays on the right of the gravity dam.
5. Demolish the right half of the dam and excavate adjacent upstream fill from El 194.5 to El 170.
6. Excavate diversion channel on Rt side through upstream fill and gravity section from El 170 to El 155 with bottom width of 20', side slopes of 2:1 through fill, and 1/4: 1 through dam. A plug will be left between the channel and reservoir. Figure 8 shows the completed diversion channel with out plugs.
7. Remove coffer dams and breach plug into reservoir in such a manner as to limit reservoir drawdown to 1 ½' per day and ramping to 1,000 cfs per hour. Draw water down to El 163+/-.
8. Mobilize heavy equipment; Demolish Rt Spillway; Place temporary bridge across the diversion channel; Demolish Lt half of gravity dam down to El 170; Demolish Lt Spillway Intake, Penstocks, Surge Tank, Power Plant above water line. Shape and contour left abutment. Excavate upstream fill to El 164.
9. In conjunction with 8, construct coffer dam to isolate the tail race wall and Power Plant from the river flows, demolish in water portion of Power Plant and tail race wall. Refill hole, shape and contour bank. Pull isolation coffer dam.
10. In conjunction with 8, and as equipment access requirements permit, excavate gravity dam from El 170 to El 164.
11. Excavate diversion channel on Lt abutment of the gravity dam through the upstream fill and the dam from El 164 to El 144. Leave plug between channel and reservoir and leave a section of the gravity dam crest in place from El 164 to 144. The concrete "plug" will prevent flows in the rock fill from moving to the left side prematurely. Figure 9 shows the completed diversion channel with out plugs.
12. Breach plug between channel and reservoir and then remove the concrete plug in such a manner as to drawdown reservoir at a rate of 1 ½' per day and ramping to 1,000 cfs per hour to elevation 152.
13. Excavate gravity dam and fill from El 164 to El 153, developing equipment access ramp along Rt slope upstream of the dam.

14. Deepen diversion channel on Lt through fill and gravity dam from El 144 to El 133. Leave plug between channel and reservoir and section of the gravity dam crest between El 144 to El 133.
15. Breach plug between channel and reservoir and then remove the concrete plug in such a manner as to limit drawdown reservoir to 1 ½' per day and ramping to 1,000 cfs per hour to elevation 141.
16. Excavate gravity dam and fill from El 153 to El 141.
17. Deepen diversion channel on Lt through fill and gravity dam from El 133 to El 121. Leave plug between channel and reservoir and section of the gravity dam crest between El 133 to El 121.
18. Breach plug between channel and reservoir and then remove the concrete plug in such a manner as to limit ramping to 1,000 cfs per hour to elevation 129.

19. Excavate gravity dam and fill from El 141 to El 130.
20. Deepen diversion channel on Lt through fill and gravity dam from El 121 to El 110. Leave plug between channel and reservoir and section of the gravity dam crest between El 121 to El 110.
21. Breach plug between channel and reservoir and then remove the concrete plug in such a manner as to limit ramping to 1,000 cfs per hour to elevation 118.
22. Excavate gravity dam and fill from El 141 to El 119.
23. Deepen diversion channel on Lt through fill and gravity dam from El 110 to El 99. Leave plug between channel and reservoir and section of the gravity dam crest between El 110 to El 99.
24. Breach plug between channel and reservoir and then remove concrete plug in such a manner as to limit ramping to 1,000 cfs per hour to elevation 107.
25. Excavate gravity dam and fill from El 119 to El 108.
26. Deepen diversion channel on Lt through fill and gravity dam from El 99 to El 90. Leave plug between channel and reservoir and section of the gravity dam crest between El 99 to El 90.
27. Breach plug between channel and reservoir and then remove concrete plug in such a manner as to limit ramping to 1,000 cfs per hour to elevation 98.
28. Excavate gravity dam and fill from El 108 to El 99.
29. Remove downstream caisson and sheet piles working from El 99 bench
30. Complete removal of fill and gravity dam from El 99 to 90.
31. Clean up channel of any debris. Work way back up slope, pulling equipment ramp in the process.

- Changes from the Baseline Concept:
- Eliminates need for barging equipment or constructing floating bridge.
- Eliminates need for extensive upstream coffer dams and importing of fill material. Clean material from upstream fill can be used for coffer dams about the tail race wall and power plant.
- Eliminates the need for excavation, including rock, for an upstream diversion channel and subsequent refill.

Advantages	Disadvantages
• Eliminates rock excavation in Lt spillway and Lt side of channel. • Disturbs less area outside of the immediate footprint of the dam, resulting in less reshaping. and disturbance of cultural site • Provides for control of reservoir drawdown and ramping of downstream flows to meet criteria. • Simplifies equipment access to the left abutment. • May decrease the overall construction time.	• Increases the amount of in-water work for deepening the diversion channel and may increase the impact of "fish windows" on construction progress. •

Potential Risks
None apparent at this time.

Cost Items	Nonrecurring Costs
Original Baseline Concept	$ 1,615,500
Value Concept	$ 157,500
Avoidance	$ (1,458,000)
Value Study Costs	$ 20,000
Implementation Costs	$ 30,000
Net Avoidances	**$ (1,408,000)**

Figure 6. Schedule, sheet 1 of 2

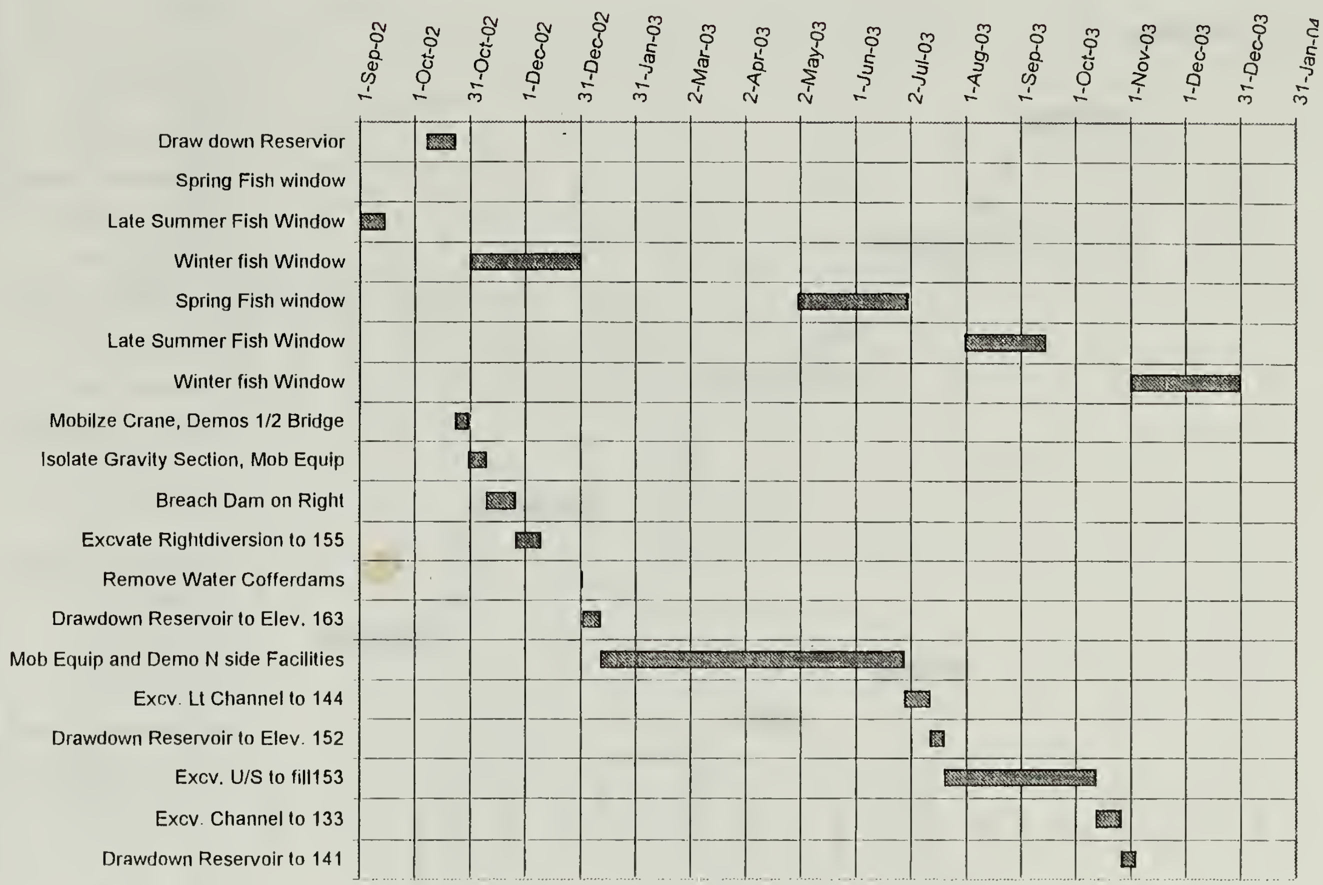


Figure 7. Schedule, sheet 2 of 2.

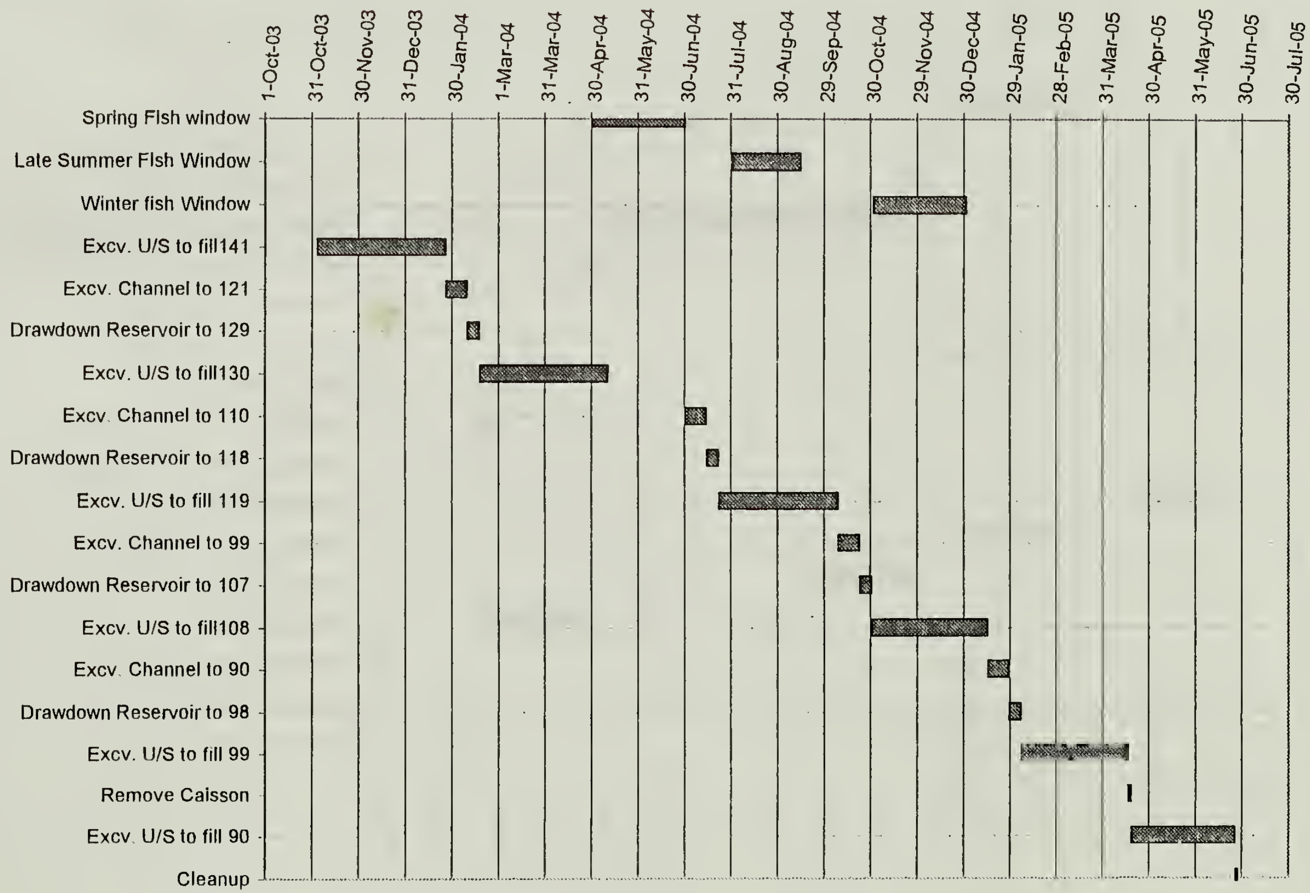


Figure 8: Right Diversion Channel

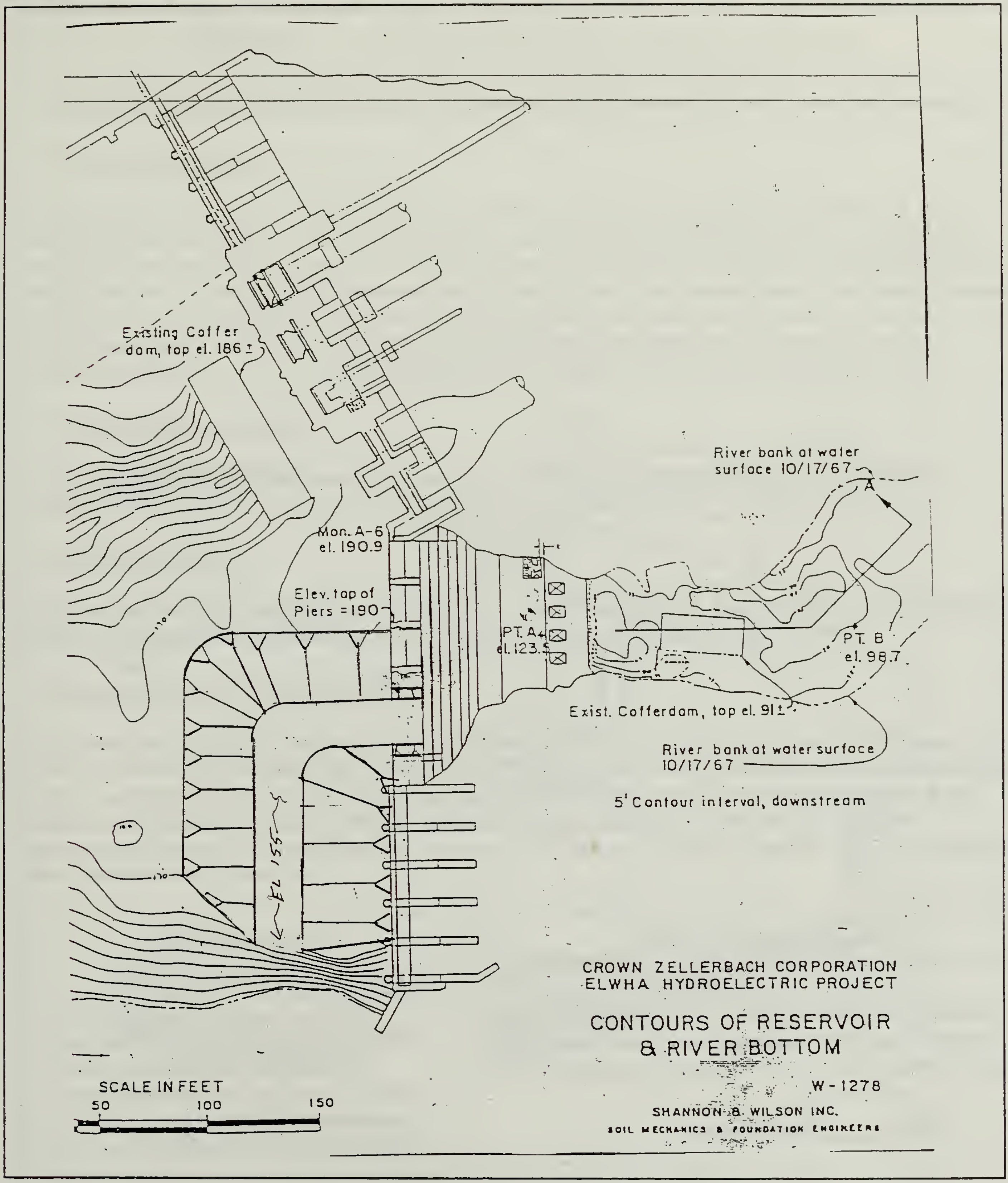
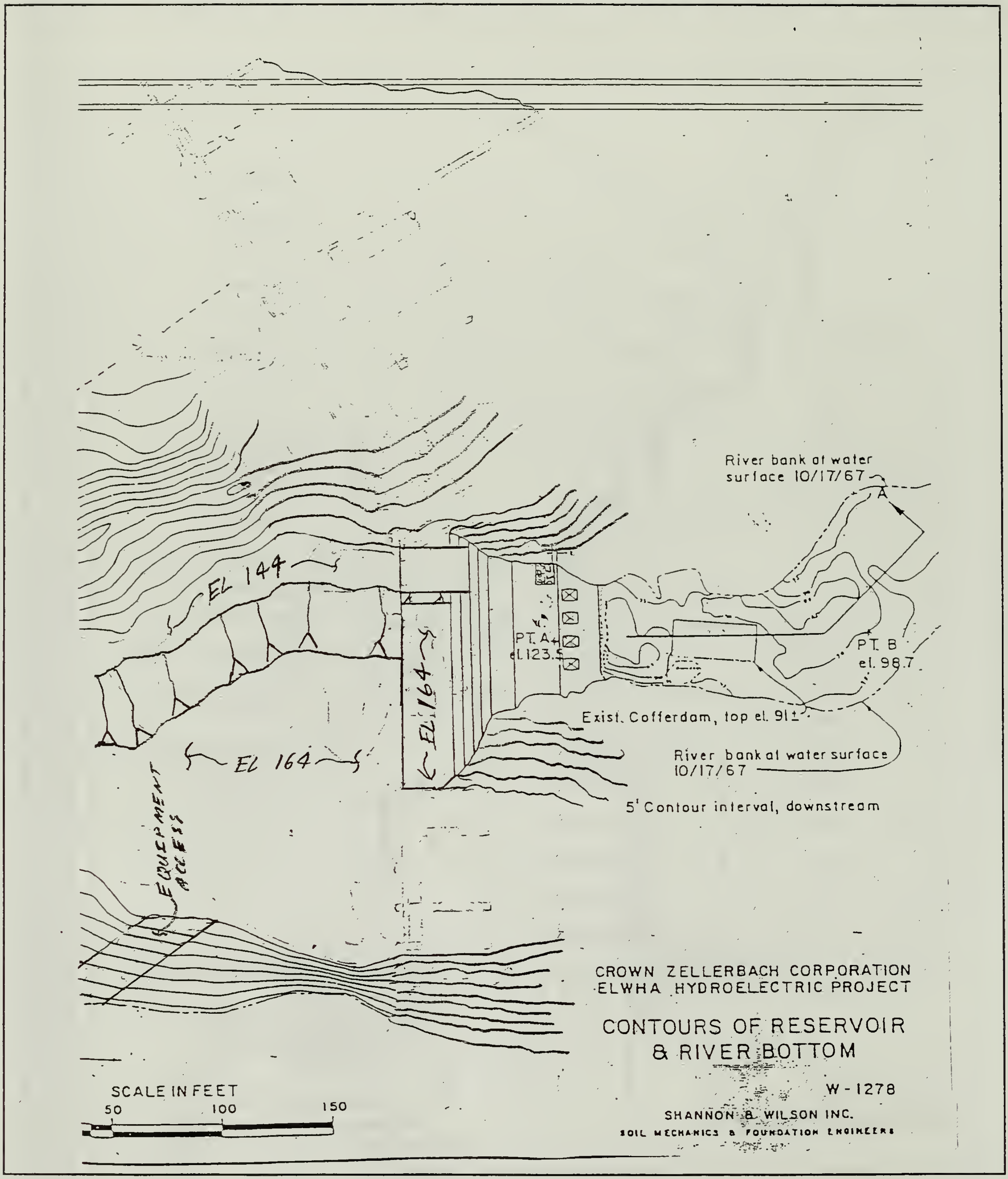


Figure 9. Left Diversion Channel



Project: Elwha River Restoration, Elwha Dam Removal

Proposal No. 3. Landscape Contouring of Left Side Intake, Penstock and Power House Area

- Proposal Description:

The proposal would be to create a "ridge" in the area of the left spillway and penstocks up to perhaps elevation 220+/-. See Figure 10. This would create a more natural looking topography and eliminate long distance hauling of approximately 50,000 cy of material. The proposal would leave portions of the left (north) spillway and intake in place and buried under the ridge of natural materials. The VE team feels that the uniformity of this area looks very un-natural, and feels that this area could be used as a waste area to dispose of lower spillway and intake structure concrete and cover with rock fill and other natural materials with minimum hauling required.

- Critical Items to Consider:

Extra design effort may be needed to place and retain fill material on the existing left (north) spillway rock channel with its steep slope and smooth rock.

- Ways to Implement:

A landscape architect could propose contours in this area, and the design team could determine the most appropriate material and the best time and method to place the material.

- Changes from the Baseline Concept:

The Baseline Concept shows a large flat area at elevation 170 with a large uniformly sloped area down to the river at elevation 90. The VE Proposal is to use this area as a waste area to dispose of approximately 50,000 cy of material and at the same time create a more natural appearing hillside. Foundation portions of the spillway and intake structures would be left in place, eliminating the need for demolition and removal. The ridge of natural materials would be placed over the remaining concrete.

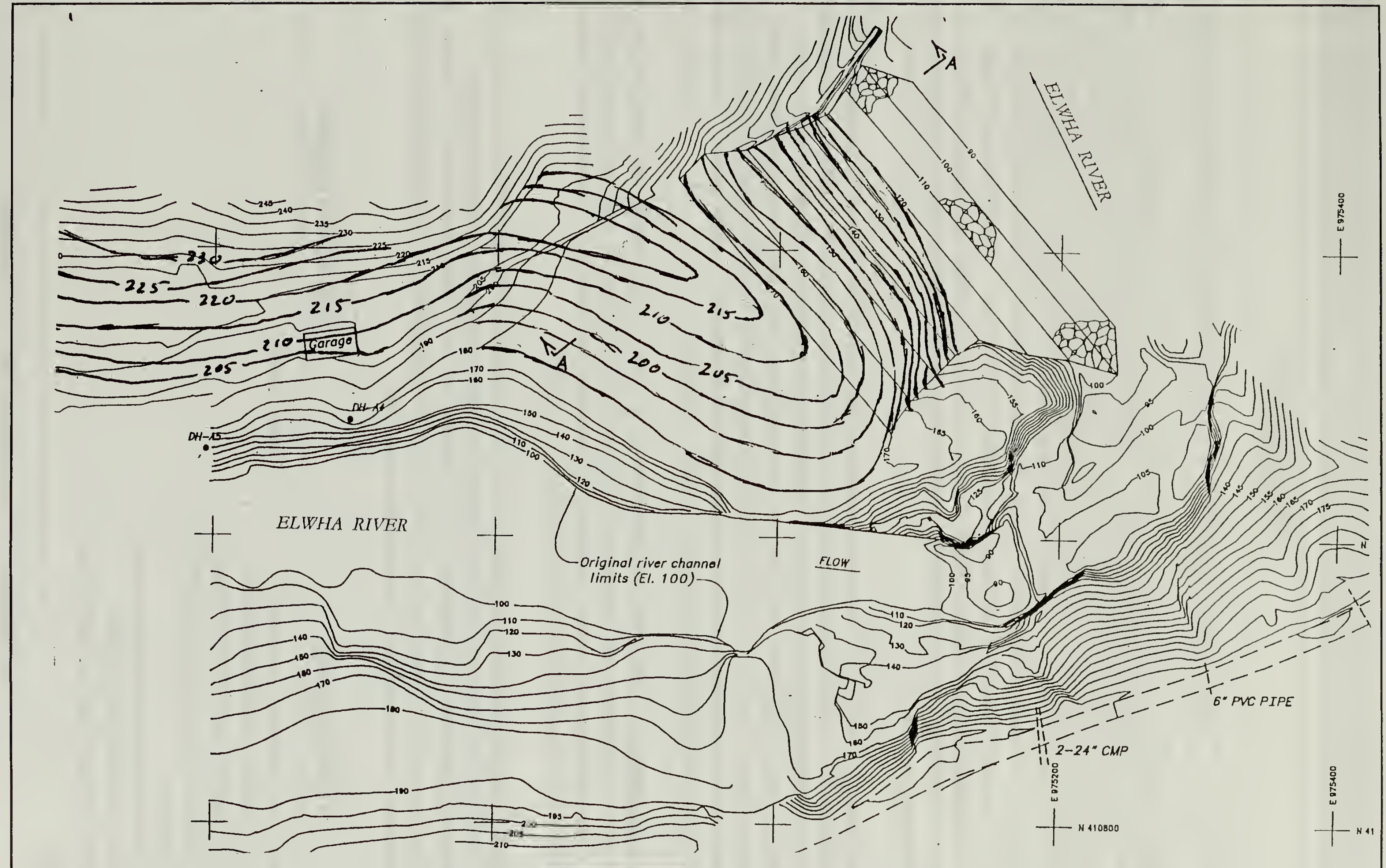
Advantages	Disadvantages
• This proposal creates a~~nd~~ more natural looking landscape and minimizes the haul distance of approximately 50,000 cy of material. • This proposal leaves approximately 660 cy of spillway concrete and 375 cy of intake structure concrete in place.	• The material may have to be sorted and graded to eliminate man made materials such as concrete and reinforcing steel near the surface of the ridge.

Potential Risks

This material would have to be placed while there is still access to the left side. This could complicate the project schedule.

Cost Items	Nonrecurring Costs
Original Baseline Concept	$ 500,000
Value Concept	$ 200,000
Avoidance	$ (300,000)
Value Study Costs	$ 0
Implementation Costs	$ 0
Net Avoidances	**$ (300,000)**

Figure 10. Slope Contours, left side Elwha Dam.



Proposal No. 4

Description

Proposal No. 4. Draw Down Lake Mills Prior to Dam Removal Using Existing Facilities.

- Proposal Description: Draw down Lake Mills and redistribute delta sediments using existing spillway and penstock to elevation ~515 ft. following decommissioning of Glines Canyon Dam approximately 6 months prior to dam removal. Each drawdown increment to elevation ~515 ft. will be 10 ft. Drawdown rates per 10' increment to elevation ~515 ft. would be as rapid as possible (consistent with slope stability requirements) to accomodate maximum sediment redistribution between increments. Each 10' drawdown would be followed by 10 days to 2 weeks at constant elevation to facilitate sediment redistribution. Dam demolition will commence following drawdown of the reservoir and will proceed at rates unconstrained by sediment redistribution considerations to elevation ~515 ft. and as per the baseline concept below elevation ~515 ft.

- Critical Items to Consider: Once lake elevations are lower than that of the spillway, drawdown to elevation~515 ft. will be made using the existing power penstock. Drawdown rates will be limited by the capacity of the penstock. Drawdown through the penstock will be most effective during the summer and fall low flow seasons. As in the base condition, dam demolition below elevation ~515 ft. will still be constrained by stoppages dictated by fish requirements, hydrology, or downstream sediment transport considerations. The powerplant will be decommissioned 6 months prior to dam removal.

- Ways to Implement: Drawdown to elevation ~515 ft. will be accomplished using BOR project personnel. Construction to elevation ~515 ft. will occur in the dry, and can be accomplished using methods deemed by the contractor to be most cost-effective. Construction below elevation ~515 ft. will proceed as in the base condition.

- Changes from the Baseline Concept: Under this proposal Lake Mills would be drawn down approximately 65 feet more prior to dam removal than under the baseline concept. Drawdown increments to elevation ~515 ft. would be 10 ft. rather than the 7.5 ft. under the baseline concept. Construction rates would not be constrained by the sediment erosion and redistribution requirements of the baseline concept.

Advantages	Disadvantages
• Permits dam removal to elevation ~515 ft. to occur unconstrained by sediment redistribution requirements within the reservoir or downstream fish requirements. • Could accommodate alternative dam removal methods that require considerably less diamond wire saw cutting.	• None noted.

Potential Risks
Comment: This proposal could be modified to provide for more rapid drawdown of the reservoir below elevation ~515 ft. than would occur under the baseline concept (for example, by shortening the period of constant reservoir elevation between lifts. This is because by elevation ~515 ft., most coarse delta sediment redistribution within the reservoir would have occurred. Demolition rates would, however, still need to be constrained by downstream sediment concentration objectives and bedload sediment transport objectives. More rapid demolition would result in increased downstream sediment concentrations and increased potential for downstream channel aggradation.

Cost Items	Nonrecurring Costs
Original Baseline Concept	$ 12,000,000
Value Concept	$ 10,900,000
Avoidances	$ 1,100,000
Value Study Costs	$ 30,000
Implementation Costs	$ 0
Net Avoidances	**$ 1,070,000**

Description

Proposal No. 5. Draw Down Lake Mills Prior to Dam Removal Using Newly-Constructed Low-Level Outlet.

- Proposal Description: Construct low level outlet work with gate/valve control near the base of the dam at approximately elevation 425-430 ft. (see Figures 11 and 12 for one possible concept). Remove (dredge) sediment for approximately 200 ft. upstream of the dam prior to daylighting through the upstream side. Draw down Lake Mills and redistribute and release sediments using existing spillway, penstock, and low level outlet to elevation ~425 ft. following decommissioning of Glines Canyon powerplant approximately one year prior to dam removal. Each drawdown increment to elevation 470 ft. will be 10 ft. followed by 10 days to 2 weeks at constant elevation to facilitate sediment redistribution. Following sediment redistribution to elevation 470 ft. refill Lake Mills. Upon removal of Elwha Dam to elevation 110 ft. resume and complete drainage of Lake Mills. Drawdown below elevation 470 ft. will be at rates that accomodate downstream fish management, and sediment delivery and transport objectives. Dam demolition will commence following drawdown of the reservoir and will proceed at maximum rates unconstrained by fish or sediment management considerations.

- Critical Items to Consider: Partial plugging or blockage of the low-level outlet. A trash rack or means to remove blockage will have to be provided. Means to operate and maintain the outlet gate or valve will have to be provided. A combination of the spillway, penstock and low-level outlet works will be used to lower the reservoir and accommodate sediment management objectives. ~~The contractor will be required to~~ Maintain minimum instream flows by removing blockages, releasing through penstock, spilling over dam or other means. Dam ~~deconstruction~~ will be able to occur under most hydrologic conditions (with the exception of infrequent large floods).

- Ways to Implement: A separate contract for construction of the low-level outlet will be issued approximately 1-year prior to drawdown. Drawdown, large debris and sediment management will be accomplished using BOR project personnel. Dam demolition and removal will be through contract and accomplished using methods deemed by the contractor to be most cost-effective.

- Changes from the Baseline Concept: Under this proposal Lake Mills would be drained and sediment management objectives would be achieved prior to dam demolition and removal. Construction rates would not be constrained by the hydrology, fish management, or sediment erosion and redistribution requirements of the baseline concept. Most of the dam could be removed in the dry, and would not necessarily require use of controlled "lifts." Until the dam is removed to below ~elevation 450 ft., it would be possible to reestablish an upstream pool to facilitate some management of suspended sediment concentrations.

Proposal No. 5

Advantages

- Permits dam removal to occur at maximum rates unconstrained by fish, sediment management, or most hydrologic considerations.
- Shortens the period of dam removal.
- Should accommodate alternative, more cost-effective dam removal methods that require little or no diamond wire saw cutting.
- Downstream suspended and bedload sediment conditions can be more precisely managed.
- By diluting sediment releases through the low-level outlet with releases from the penstock, it may be possible to hold most sediment sediment releases to below 10,000 mg/l. Below elevation ~515 ft. suspended sediment concentration dilution could be accomplished by partially refilling the pool prior to discharging through the low-level outlet.

Disadvantages

- None noted.

Potential Risks

Construction difficulties installing the low-level outlet.
Structural considerations may limit the size of the low-level outlet.

Cost Items	Nonrecurring Costs
Original Baseline Concept	$ 12,000,000
Value Concept	$ 9,000,000
Avoidance	$ 3,000,000
Value Study Costs	$ 30,000
Implementation Costs	$ 0
Net Avoidances	**$ 2,970,000**

Figure 11. Gate

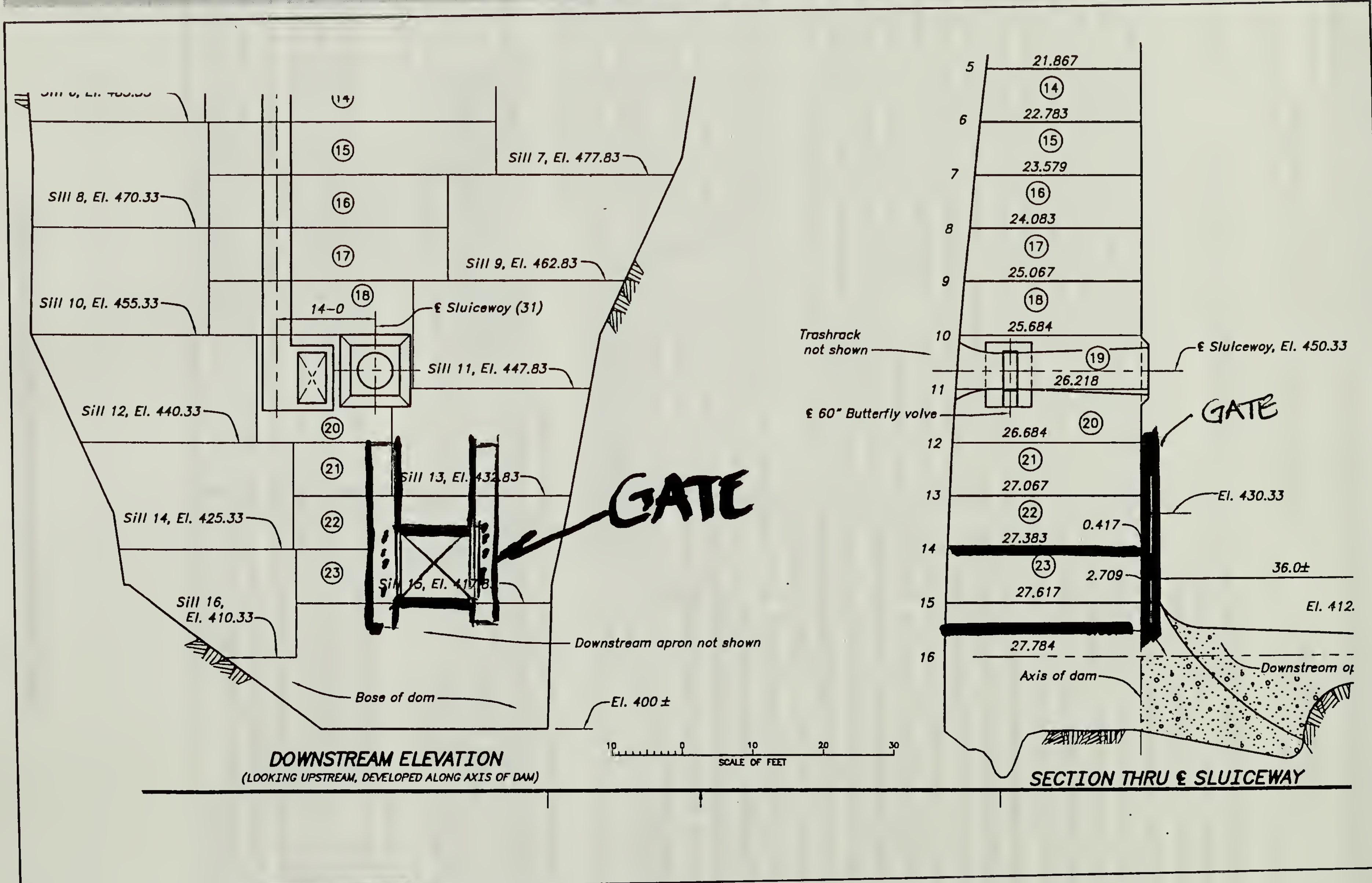
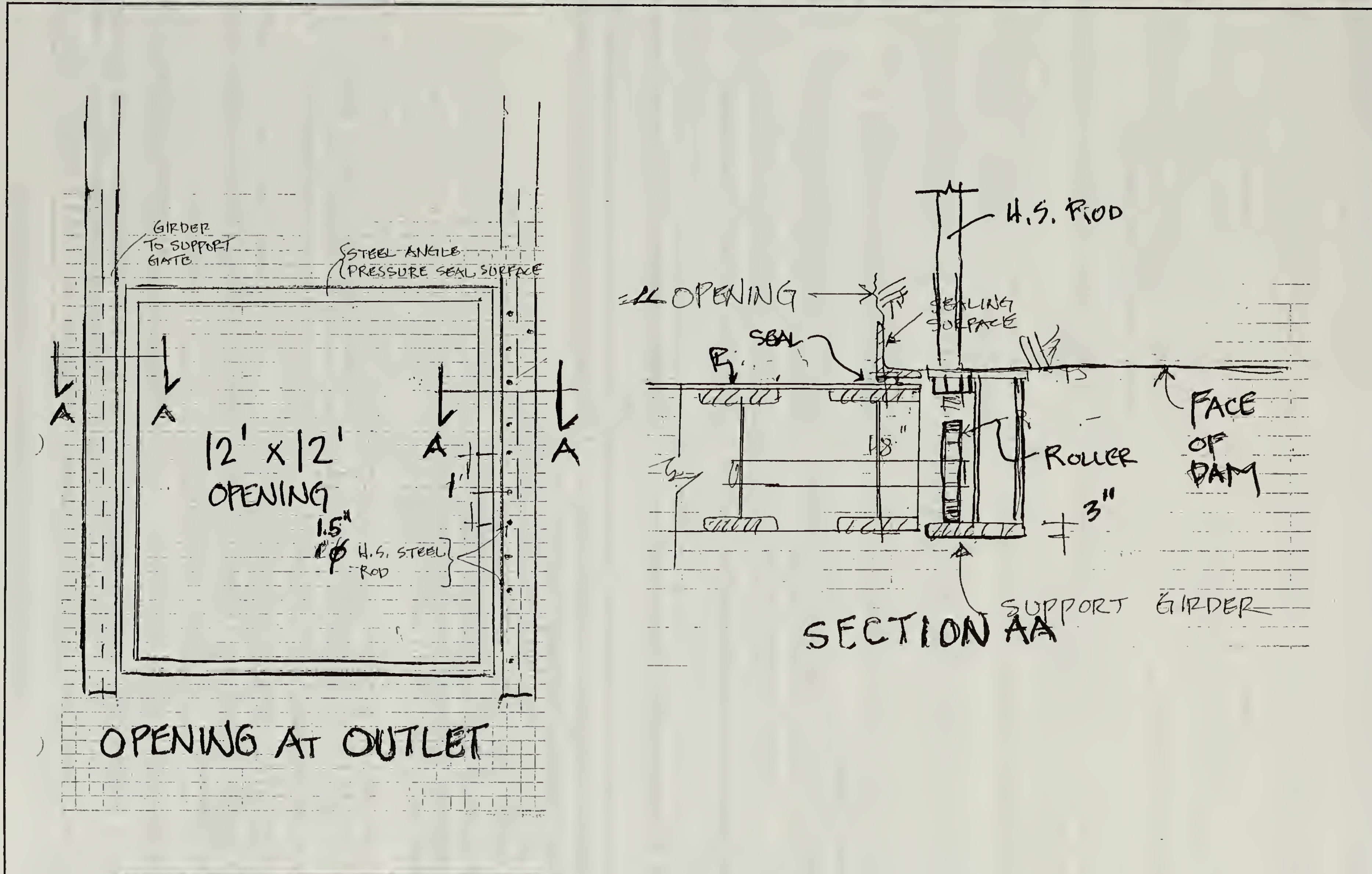


Figure 12. Opening.



Value Study Elements Considered as Potential Proposals and Their Disposition	
Idea	**Disposition**
Put the Elwha diversion on the right side	Developed as part of Proposal 2
Sell the dams on E-bay	Discarded as not satisfying goal of project ~~The team did not find a way to make this idea competitive with the baseline~~
Allow contractor to remove fines anyway he chooses except during fish windows	RFP/Negotiated contracting is already part of the baseline
Run an overhead cableway at Elwha and/or Glines	Recommended to Design Team for inclusion in specifications as Contractor's option.
Cut coupons out of Glines at or above the silt level	Discarded as not satisfying discharge criteria.
Place excavated upstream material back on benches at Elwha	Developed as part of Proposal 3
Refine/Clarify Conditions for negotiated contract	Developed as part of Proposal 1
At Elwha, minimize excavation/refill for diversion	Developed as part of Proposal 2
Size the diversion for the 10 year flood	The team determined this was not a realistic goal.
Drain both reservoirs to a level above the sediments; dredge a meander channel through sediments of the upper reservoir; Open a bottom outlet of the upper dam to establish channel and pass instream flow; dredge meander channel through sediments of lower reservoir; Open bottom outlet of lower dam	Partially developed as part of Proposal 5
Upgrade access using haul material	Deferred to Design Team for further review.
Reactivate the original diversion tunnel at Glines	Discarded in favor of Proposal 5
Leave 30' of the left end of the Glines arch and 10' of the right end	Deferred to design team for further review.
Just take out the bottom 50' of Glines	Discarded as not satisfying goal of project.
Change the "fish windows" in the schedule	Discarded as not satisfying goal of project.
Change the criteria for setting the fish windows	Developed as part of Proposal 1

Disposition of Ideas

Eliminate one November-January Fish window	Discarded as not satisfying goal of project.
Accelerate sediment movement into the river	Developed as part of Proposal 4 and 5
Breakup grout cap and lower reservoir at Elwha	Developed as part of Proposal 2
Remove Sediments, reopen sluice	Discarded as not competitive with baseline concept.
Move the diversion through/over the gravity section of Elwha	Developed as Proposal 2
Leave the bridge in place	Discarded as not competitive with baseline concept.
Build a construction bridge at Elwha	Developed as part of Proposal 2
Rubblize both dams and use conveyers to load trucks	Deferred to design team for further review.
Rubblize at low flows and clamshell from pool	Deferred to design team for further review
Drain down reservoirs 1 year before removal	Developed as Proposal 4 and 5
Create an ungated low level outlet, control by increasing size	Determined to be not competitive with baseline concept.
Redistribute the delta using existing facilities and Reclamation staff	Developed as part of Proposal 4
Let contractor decide how to take dams out	Request for Proposal/Negotiated contract includes this concept. It is already part of the baseline
Remove constraints on contractors schedule	Developed as part of Proposal 1
Remove Glines first (allow Lake Aldwell to trap sediments; construct an M&I water intake above Lake Aldwell; then remove Elwha	Discarded as not competitive with baseline concept.
Facilitate natural contouring at Elwha Powerplant and penstock	Developed as Proposal 3
Bury the penstock at the Elwha site	Discarded as not meeting goal of project
Maximize recycling opportunities; sell blocks of Glines for souvenirs, any commercial, industrial, residential use	The study team did not think this idea is likely to improve the baseline
Keep the invert of diversion at Elwha at elevation 170 and use spillway gates to regulate flows	Discarded in favor of Proposal 2

Disposition of Ideas

Ballast the toe of the gravity section at Elwha with Glines blocks	Referenced in Proposal 2 as part of stabilization, if needed
Cutoff seepage at the gravity section at Elwha with sheetpile	The study team doubts sheetpiles can be driven through the hard boulder fill
Use Glines blocks for the diversion at Elwha	Discarded in favor of Proposal 2
Take Elwha out and shotcrete the channel	Discarded as not meeting goal of project.
Create stepped pool and weir fish ladder with rubble and logs, fill the pools with sediment from Glines	Discarded as not meeting goal of project
Mechanically move delta sediments sideslopes into the river	Discarded in favor of Proposal 4 and 5
Mechanically move sediments out of the flow path	Discarded in favor of Proposal 4 and 5
Reopen the Glines Dam closure panel and sluiceway and install downstream or upstream control gate	Discarded in favor of Proposal 5
Use controlled blasting instead of saw cutting to get blocks	Deferred to Design Team for further review.
Use low level outlet to divert water while demolishing Elwha Dam	Discarded in favor of Proposal 2
Use Elwha rubble to create a fish ladder at Glines	Previously developed and presented as part of the 1996 value study of this project. Discarded as not meeting goal of project.
Siphon and/or dredge sediments at Glines	Discarded in favor of Proposal 5
Fit the Glines 60" outlet with an auger-screw to regulate fines removal	Discarded as not competitive with baseline concept.

List of Consultants

Consultant or Contact	Topic or Information
Name Rick Parker Title Elwha Program manager Organization Bureau of Reclamation Address 826 E Front St. Port Angeles, WA Phone 360-565-1322	O&M costs of dam operation following decommissioning.

Data and Documents Consulted

Title, Author, and Date	Information

Design Team Presentation Attendance List
April 21, 2003 - Noon

Name/Title/Discipline	Address/Phone Number
Norm Hyndman Value Study Team Leader General Engineer	Bureau of Reclamation, Technical Service Center PO Box 25007 (D-8170), Denver CO 80225-0007 Phone: 303-445-3251 FAX: 303-445-6475 E-mail: nhyndman@do.usbr.gov
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Design Team Presentation Attendance List
April 21, 2003 - Noon

Tom Hepler Design Team Leader Civil Engineer	Bureau of Reclamation, Technical Service Center PO Box 25007 (D-8130), Denver CO 80225-0007 Phone: 303-445-3261 FAX: 303-445-6490 E-mail: thepler@do.usbr.gov

APPENDIX

PROPOSAL 2

Item	Description	Qunatity	Unit		Unit Cost	Total Item Cost
	Cost Estimate Diversion through Dam Only					
1	Mobilization	1	LS		$ 61,045	$ 61,045
1.2	Flexi Float Rental	1	LS		$ 60,000	$ 60,000
3.1	F&I Pre Cast Concrete	1	LS		$ 54,000	$ 54,000
3.2	Pervious Sand and GravelBackfill for double wall units	200	CY		$ 36	$ 7,200
3.3	F&I Sheet Piles w/ Tiebacks	200,000	lb		$ 1	$ 200,000
3.4	Pervious Sand and Gravel Backfill for Sheet Pile cofferdam	2,000	CY		$ 36	$ 72,000
6.1	Rock Exc. D/S Cofferdam to El. 135	6,300	CY		$ 15	$ 94,500
6.2	Common Exc. U/S Cofferdam to 135	50,000	CY		$ 7	$ 350,000
6.3	Common Exc. Landslide Area to el. 110	10,000	CY		$ 7	$ 70,000
7.1	Remove Double Wall Units form Approach	1	LS		$ 75,000	$ 75,000
7.2	Remove Sheet Piles w/ Tiebacks	200,000	lb		$ 0	$ 80,000
7.3	Remove doublewall Units from diversion Channel	1	LS		$ 40,000	$ 40,000
7.4	Pervious Sand and Gravel Backfill	400	CY		$ 36	$ 14,400
7.5	Rock Exc. In Channel Plug	2,400	LS		$ 36	$ 86,400
17.1	Place and Compact Rockfill for Rip-rap	2,900	CY		$ 6	$ 17,400
	Subtotal					$ 1,281,945
	Unlisted Items			5%		$ 64,097
	Subtotal					$ 1,346,042
	Contigencies			20%		$ 269,208
	Subtotal					$ 1,615,251

	Add on Costs					
	Temporary Water Filled Coffer dams	150	LF		$ 500	$ 75,000
	Temporary Bridge	1	LS		$ 50,000	$ 50,000
	Subtotal					$ 125,000
	Unlisted Items			5%		$ 6,250
	Subtotal					$ 131,250
	Contigencies			20%		$ 26,250
	Subtotal					$ 157,500
	Feasibility Analyis of Dam Stability	1	LS		$ 30,000	$ 30,000
	Total Additional Costs					$ 187,500
	Savings					$ 1,427,751

[signature] 4/24/03

[signature] 4/24/03

CODE: D-8170

ESTIMATE WORKSHEET

FEATURE: 24-Apr-03

Elwha Dam Removal

Landscape Contouring of Left Side

Proposal 3

WOID:

PROJECT: **Elwha River Restoration**

REGION:

FILE: C:\123R5W\WORK\Elwha\Elwha-Glines Dam Removal\[Elwha Dam Landscape Contouring of Le

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Original Baseline Concept					
	4	Haul Material to Waste (10 mile haul)		50,000.00	cy	$6.00	$300,000.00
	2	Remove Reinf Conc in N Spillway Gate Structure		660.00	cy	$180.00	$118,800.00
	3	Remove Rinf Conc in Intake Structure		375.00	cy	$180.00	$67,500.00
	4	Place & Compact Waste Materials for Site Disposal		1,035.00	cy	$11.00	$11,385.00
		Subtotal Baseline					$497,685.00
		VE Study Alternative					
	4	Place Mtrl, Compact to Stable Slope		50,000.00	cy	$4.00	$200,000.00
		Subtotal VE Alternative					$200,000.00
		Net Change					$297,685.00
		Say					$300,000.00

QUANTITIES		PRICES	
BY Dan Drake	CHECKED	BY DLM	CHECKED WDE
DATE PREPARED 24-Apr-03	APPROVED	DATE 24-Apr-03	PRICE LEVEL VE Study Alternative

CODE: D-8170

ESTIMATE WORKSHEET

FEATURE: Proposal # 4

Glines Canyon Dam Removal

Alt 1A

24-Apr-03

WOID:

PROJECT: Elwha River Restoration

REGION:

FILE: C:\123R5W\WORK\Elwha\Elwha-Glines Dam Removal\[Glines Dam Removal Alt 1A.xls]Sheet 1

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	4	Reduce Crane/Crew Requirement		200.00	days	-$3,500.00	-$700,000.00
	2	Reduce Saw Cutting					
		- Saw Cutting		10,000.00	sf	-$80.00	-$800,000.00
		- Setups		5.00	each	-$5,400.00	-$27,000.00
	3	Reduce Drill & Blast					
		- Drilling		10,000.00	lf	-$42.00	-$420,000.00
		- Blasting		1,000.00	holes	-$150.00	-$150,000.00
		Total Deletions					-$2,097,000.00
	4	Add Mechanical Demolition		5,000.00	CY	$100.00	$500,000.00
	5	Add Reclamation Cost		1.00	ls	$500,000.00	$500,000.00
		Total Additions					$1,000,000.00
		Net Change					-$1,097,000.00
		Say					-$1,100,000.00

QUANTITIES		PRICES	
BY VE Team	CHECKED	BY	CHECKED RICC 4/29/03
DATE PREPARED 24-Apr-03	APPROVED	DATE 24-Apr-03	PRICE LEVEL VE Study Alternative

CODE: D-8170

ESTIMATE WORKSHEET

FEATURE: Proposal X 5

24-Apr-03

Glines Canyon Dam Removal

Alt 1B

WOID:

PROJECT: **Elwha River Restoration**

REGION:

FILE: C:\123R5W\WORK\Elwha\Elwha-Glines Dam Removal\[Glines Dam Removal Alt 1B.xls]Sheet 1

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Reduce Crane/Crew Requirement		286.00	days	-$3,500.00	-$1,001,000.00
	2	Delete Saw Cutting					
		- Saw Cutting		31,600.00	sf	-$80.00	-$2,528,000.00
		- Setups		108.00	each	-$5,400.00	-$583,200.00
	3	Delete Drill & Blast		1.00	ls	-$2,850,000.00	-$2,850,000.00
		Total Deletions					-$6,962,200.00
	4	Add Mechanical Demolition		16,800.00	CY	$100.00	$1,680,000.00
	5	Add Reclamation Cost		1.00	ls	$500,000.00	$500,000.00
	6	Add Low Level Outlet Works (12'x12')					
		- Tunnel		1.00	ls	$375,000.00	$375,000.00
		- Mechanical		1.00	ls	$750,000.00	$750,000.00
		- Trash		1.00	ls	$375,000.00	$375,000.00
	7	Add U/S Excavation of Sediments		15,000.00	cy	$15.00	$225,000.00
		Total Additions					$3,905,000.00
		Net Change					-$3,057,200.00
		Say					-$3,000,000.00

QUANTITIES		PRICES	
BY VE Team	CHECKED	BY	CHECKED RKC 4/24/03
DATE PREPARED 24-Apr-03	APPROVED	DATE 24-Apr-03	PRICE LEVEL VE Study Alternative